

or two slots. The removable bushing plates used with this frame have holes or hinged binders to correspond with these pins or slots and so are correctly located.

Guide Bushings attached to Drills. - When several small holes necessitating two or more operations are to be machined, the following plan works well from a production standpoint. Guide bushings of the same diameter are fastened to the drills, reamers and other tools to locate them in the bushings in the plate, which are uniform in diameter. Thus, when drilling or reaming, the tools will be guided from the bushing *A*, Fig. 21. This method is not recommended for holes over one inch deep, as there is a tendency for the drills to spring out of alignment, especially if the drilling is done against a rough surface, since the end of the drilling tool will be some distance from the auxiliary bushing guiding it. This arrangement is effective for drilling steel, as the space between the jig plate and the work allows room for the curled chips. The diameter of the guide bushing, however, must be kept as small as possible, since this piece has a tendency to heat and stick owing to the peripheral speed. This sticking and the wear on the bushing plate may be avoided by using a stationary pilot similar to that shown in Fig. 22. A Z-shaped casting with a bore equal to the tool size and a nose equal to the jig bushing diameter is secured to the arm of the multiple-spindle drilling machine by a bolt that extends through the slot in the arm, as shown in the illustration.

General Notes on Bushings. —•• When accurate work is necessary, the bushings should support the cutting tool to within one diameter of the tool from the work. If a *Winrh* drill is used, the end of the bushing should not be more than  $\frac{1}{4}$  inch from the work, and it may be carried to within  $\frac{1}{8}$  inch of the work. Bushings should not be located close to the work with the object of carrying the chips up through the bushing. It is much better to provide other means in the jig for the removal of the chips,

The shape of the work frequently requires bushings of considerable length in order to carry the cutting tool close to the work. When the length exceeds four diameters of the tool to be guided, the bushing presents considerable friction surface.